

## **Report of an Industrial Hygiene Field Investigation**

### **Visitor Center at a NWR Mold Evaluation June 4-5, 2014**

#### **I. Introduction**

An industrial hygiene investigation was conducted to evaluate and indoor air complaint at the Visitor Center at a National Wildlife Refuge.

#### **II. Applicable Recommendations: Note: There is no Federal Regulation for Mold**

American Conference of Governmental Industrial Hygienist (ACGIH) – Indoor Air Quality

U.S. EPA and NIOSH – Building Air Quality

American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) – Ventilation Controls

#### **III. Procedure**

##### **A. Field Instruments Used**

<b>ID#</b>	<b>Instrument</b>	<b>Calibration Date</b>
13	Bio Pump Plus – 15 LPM	5/29/2014
8	Gast Model 1532-107-G557X , 0703241465, 24.4 LPM	5/29/2014
	TSI, IAQ Meter 8760	

##### **B. Methods of Analysis**

<b>Hazardous Substance or Physical Agent</b>	<b>Sampling Method</b>	<b>Analytical Method</b>
Mold	Zefon Sampler & Air-o-cell cassette	Microscopic
Mold	High Volume Pump And MCE Filter	Microscopic
Indoor Air	TSI, IAQ Meter 8760	Direct Reading

## IV. Findings

**Table 1 Air-O-Cell Total Mold Analysis**

Sample Number	Location	Time	Time	Volume	Mold Type	Counts	Spores/M3	%
1635225	Trailer	9:10	9:15	75	Basidiospores	45	2600	55
					Miscellaneous Unidentified	10	580	12
					Cladosporium Species	10	580	12
					Myxomycetes/Rusts/Smuts	6	350	7.4
					Ascospores	5	290	6.2
					Hyphae	3**	170	3.6
					Aspergillus/Penicillium Species	2**	120	2.6
					Periconia Species	1**	58	1.2
					Total	82	4700	
1635226	PL Office	9:21	9:26	75	Basidiospores	56	3300	62
					Cladosporium species	12	700	13
					Ascospores	11	640	12
					Miscellaneous unidentified	4	230	4.3
					Hyphae	3**	170	3.2
					Myxomycetes/Rusts/Smuts	2**	120	2.3
					Aspergillus/Penicillium species	2**	120	2.3
					Total	90	5300	
1635227	Employee	9:37	9:42	75	Basidiospores	55	3200	54
					Aspergillus/Penicillium species	17	990	17
					Miscellaneous unidentified	8	470	8.0
					Hyphae	7	410	6.9
					Cladosporium	7	410	6.9
					Ascospores	7	410	6.9
					Scopulariopsis species	1**	58	0.98
					Total	110	6300	
1635228	Visitor Center	9:43	9:48		Basidiospores	57	330	52
					Cladosporium species	17	990	16
					Miscellaneous unidentified	14	810	13
					Aspergillus/Penicillium species	8	470	7.5
					Hyphae	6	350	5.6
					Ascospores	4	230	3.7
					Periconia species	1**	58	0.92
					Alternaria species	1**	58	0.92
					Total	110	6300	

1635229	Outside	9:53	9:55	30	Basidiospores	150	22,000	54
					Miscellaneous unidentified	71	10,000	24
					Ascospores	34	4900	12
					Cladosporium species	18	2600	6.3
					Aspergillus/Penicillium species	4	580	1.4
					Alternaria species	2**	290	0.71
					Torula species	1**	150	0.37
					Polythrincium species	1**	150	0.37
					Total	280	41,000	
1635230	VC Office's	9:59	10:04	75	Basidiospores	29	1700	50
					Cladosporium species	10	580	17
					Miscellaneous unidentified	6	350	10
					Hyphae	5	290	8.5
					Scopulariopsis Species	4	230	6.8
					Ascospores	4	230	6.8
					Myxomycetes/Rusts/Smuts	1**	58	1.7
					Total	59	3400	
1635231	Main-tenance Shop	10:10	10:15	75	Basidiospores	110	6100	79
					Aspergillus/Penicillium species	8	470	6.1
					Cladosporium species	6	350	4.5
					Miscellaneous unidentified	5	290	3.8
					Hyphae	4	230	3.0
					Ascospores	3**	170	2.2
					Periconia species	1**	58	0.75
					Total	130	7700	
1635232	Basement	10:40	10:42	30	Aspergillus/Penicillium species	220*	220,000*	88
					Basidiospores	120	18,000	7.2
					Hyphae	31	4500	1.8
					Miscellaneous unidentified	27	3900	1.6
					Cladosporium species	8	1200	0.48
					Ascospores	5	730	0.29
					Scopulariopsis species	3**	440	0.18
					Arthrinium species	1**	150	0.060
					Myxomycetes/Rusts/Smuts	1**	150	0.060
					Nigrospora species	1**	150	0.060
					Total	400*	250,000*	
					For estimated counts: Aspergillus/Penicillium species calculated from 198			
1635233	Mech Room	10:44	10:49	75	Basidiospores	21	1200	48
					Miscellaneous unidentified	7	410	16
					Aspergillus/Penicillium species	6	360	14
					Cladosporium species	5	290	12
					Hyphae	4	230	9.2
					Total	43	2500	

\*\*indicates a value below the reporting limit (RL)

**Table 2 - Percent of Mold Inside Compared to Outside Air**

<b>Sample Number</b>	<b>Location</b>	<b>Total Mold Count</b>	<b>% of Outside Air</b>
1635225	Trailer	4700	11.4
1635226	PL Office	5300	12.9
1635227	Employee's Office	5900	14.4
1635228	Visitor Center	6300	15.3
1635229	Outside	41,000	
1635230	VC Office's	3400	8.29
1635231	Maintenance Shop	7700	18.8
1635232	Basement	250,000	610
1635233	Mechanical Room	2500	6.10

**Table 3 Bulk Sample of Carpet and Supply Duct**

<b>Field Number</b>	<b>Location</b>	<b>Time</b>	<b>Mold Species</b>	<b>Counts (# x Dilution Factor)</b>	<b>Concentration CFU/g</b>	<b>%</b>
1635234	Main Office Duct	11:19	Cladosporium Species	21 x 100	25,000	49
			Penicillium Species	12 x 100	14,000	27
			Aspergillus Candidus	7 x 100	8,300	16
			Malbranchea species	1 x 100	1200	2.4
			Curvularia species	1 x 100	1200	2.4
			Basidiomycetes	1 x 100	1200	2.4
			Total		51,000	
1635235	Main Office Floor	11:26	Cladosporium Species	16 x 1000	23,000	70
			Basidiomycetes	3 x 1000	4300	13
			Alternaria species	2 x 1000	2900	8.8
			Penicillium Species	4 x 100	570	1.7
			Rhodotorula species	4 x 100	570	1.7
			Engyodonium Album	3 x 100	430	1.3
			Aureobasidium Pullulans	1 x 100	140	0.42
			Aspergillus Niger	1 x 100	140	0.42
			Malbranchea species	1 x 100	140	0.42
			Mucor species	1 x 100	140	0.42
			Phoma species	1 x 100	140	0.42
			Pithomyces species	1 x 100	140	0.42
			Total		33,000	

635236	VC Office Floor	12:51	Basidiomycetes	6 x 1000	21,000	45
			Cladosporium Species	4 x 1000	14,000	30
			Alternaria species	2 x 1000	7100	15
			Rhodotorula species	6 x 100	2100	4.5
			Aureobasidium pullulans	2 x 100	710	1.5
			Epicoccum nigrum	2 x 100	710	1.5
			Mucor species	2 x 100	710	1.5
			Aspergillus niger	1 x 100	360	0.77
			Curvularia species	1 x 100	360	0.77
			Phaeoannellomyces species	1 x 100	360	0.77
			Total		47,000	
1635237	VC Office Vent	1:13	Non-Sporulating Fungi	1 x 100	100	100
			Total		100	
1635238	Carpet in front of Bathroom	1:29	Cladosporium species	24 x 100	11,000	38
			Yeast	18 x 100	8200	28
			Aureobasidium Pullulans	7 x 100	3200	11
			Alternaria species	6 x 100	2700	9.3
			Sporobolomyces species	2 x 100	910	3.1
			Miscellaneous Species	2 x 100	910	3.1
			Basidiomycetes	2 x 100	910	3.1
			Penicillium species	1 x 100	450	1.6
			Rhodotorula Species	1 x 100	450	1.6
			Aspergillus niger	1 x 100	450	1.6
			Total		29,000	

**Table 4 - RH, CO<sub>2</sub>, CO, and Temperature**

Date/Time	Location	Relative Humidity	Carbon Dioxide	Carbon Monoxide	Temperature
6/4/2014 2:40 PM	Main Office	51.0	901	2.3	77.0
6/4/2014 3:30 PM	VC Office	62.0	516	3.5	69.3
6/5/2014 7:30 AM	VC Office	52.3	387	2.4	71.6

**Observations:**

**Trailer** – The trailer is located behind the office/visitor center. It was reported that the trailer was not being used for offices at this time. The trailer has a large area that is used for a break room for lunch, staff meetings, and storage. The trailer is serviced by a normal trailer heating unit. The duct work is not lined on the interior. There was no visible mold growth, but the trailer could use some housekeeping as the carpet needs to be cleaned and all surfaces could use a deep cleaning.

**Visitor Center/Office Area** – The Visitor Center and Office area is supported by two heating and cooling units. The supply and return ducts supporting these units are lined on the inside with insulation. This is a potential source of bioactivity as this allows dust and debris to be collected in the insulation. Supply ducts

run up into the attic to supply air overhead and the return ducts are ran underneath into the subbasement. Both units were inspected on the inside to ensure water in the drip pan was draining correctly and not creating a potential source of water to cause the duct work to become bioactive. Both units were operating correctly.

It was reported that on two occasions during the winter the hold tanks for the septic system had overflowed causing grey water to soak the carpet and potentially the wall during the winter near the bathroom. This has been a reoccurring problem as a sensor was installed previous in the hallway outside the bathrooms to detect water moisture from the tank backing up. If the detection system is activated, an alarm is sent to a monitoring company and the Refuge Law Enforcement Officer is notified. During the last two incidents that water was wet vacuumed up but the carpet was never cleaned. Water from the back-up was also reported to have drained down into the subbasement of the building. It was also reported that the septic lines had frozen during the winter and the maintenance worker had to thaw out the lines in the subbasement.

The Visitor Center was divided into two areas to create office space for employees in March of 2013. A wall was installed to create three cube offices in the visitor center. The wall goes to the ceiling deck and has a door in it to allow access to the office area. This wall may interfere with the proper function of the air handling unit for this area. The temperature sensor is located in the office area. The temperature on June 4 in the Visitor Center area was much warmer than the Visitor Center Office Space.

**Maintenance Shop** – The maintenance shop is located across the parking lot from the Office/Visitor Center. The maintenance employee has an office located in the heated section of the building. It was reported that the maintenance shop used to be one level, but a second story was added to the building to provide additional storage.

#### **Types of evaluations conducted by space:**

Evaluations were conducted ranging from Visual Inspection, Air-O-Cell Total Mold Evaluation, and Bulk Dust Evaluation from Carpet/Supply Ducts. A listing per room is provided:

Trailer – Visual inspection and no visible sign of mold growth was observed. It was noted that carpet needed to be clean. Air-O-Cell Total Mold Sample collected.

Office 1 (assist PL) – Visual inspection and no visible sign of mold growth was observed.

Office 2 (PL) – Visual inspection and no visible sign of mold growth was observed. Air-O-Cell Total Mold Sample collected.

Cubicle in Main Office– Visual inspection and no visible sign of mold growth was observed.

Main Office Area – Visual inspection and no visible sign of mold growth was observed, but dirt from vent observed on ceiling. Air-O-Cell Total Mold Sample collected. Bulk samples were collected from the supply duct and carpet. Note: Visual inspection of bulk sample from vent showed heavy loading of material in insulation of duct. Visual inspection of bulk sample from carpet showed heavy loading of material in carpet. The carpet in the main office area and visitor center was last cleaned approximately three years ago.

Women's Bathroom – Visual inspection and no visible sign of mold growth was observed.

Men's Bathroom – Visual inspection and a visible small water stain was on ceiling was noted.



Hallway to Bathroom – Visual inspection and the carpet was visibly dirty and light water stain observed. No staining on drywall observed, but informed staff that there may be possible contamination in the wall cavity because of water wicking up drywall. A bulk sample was collected from the carpet in front of the bathroom. Limited amount of material was collected compared to the carpet in the main office.



Visitor Center Lobby – Visual inspection and no visible sign of mold growth was observed. Air-O-Cell Total Mold Sample collected.

Visitor Center Offices – Visual inspection and no visible sign of mold growth was observed. Air-O-Cell Total Mold Sample collected. Bulk samples were collected from the supply duct and carpet. Note: The supply duct was very clean and limited dust was collected from the supply duct. The carpet had less material than the carpet in the main office.



Mechanical Room – Visual inspection showed water staining of ceiling near air handling units. Air-O-Cell Total Mold Sample collected.



Basement - Visual inspection and no visible sign of mold growth was observed. Note: The basement has a gravel floor. Air-O-Cell Total Mold Sample collected.

Maintenance Shop – Visual inspection showed visible back mold stains on ceiling. The source of the water for the mold was pipes that used to drain the roof prior to the addition of the second level. These pipes were uninsulated and carried rain water off the roof. Moisture was along the floor was observed in the maintenance shop from ground water seeping into the brick. Mold was observed growing of spider carcasses and other organic material.



## **Findings:**

### **Total Mold Spore Evaluation:**

#### **Evaluation of Mold Species Compared to Outside Air:**

ACGIH and NIOSH states that indoor air samples shall be compared to outside air samples to determine if there is a potential for active growth inside the building. If species concentrations exceed outside air, this indicates active growth inside the space. Aspergillus/Penicillium species exceeded outside air level of 580 Spores/M<sup>3</sup> in the Main Office which had 990 Spores/M<sup>3</sup> and the Basement which had 220,000 Spores/M<sup>3</sup>. The high level of Aspergillus/Penicillium spores in the Basement can cause increase levels in the Visitor Center/Office if the build should become negatively pressurized allowing air to flow from the basement into the Visitor Center/Office. Note: Return ducts run in the basement space. No visible damage to the ducts was noted or this would increase the Aspergillus/Penicillium Level in the occupied space.



#### **Outside air intake**

#### **Percent Mold Compared to Outside Air**

ACGIH and NIOSH recommend that the mold level inside the building should be less than 10% of the total mold count of the outside air. Table 2, Percent of Mold inside Compared to Outside Air show this recommendation is exceeded in the following spaces: Trailer, Rich King's Office, Main Office, Visitor Center, Maintenance Shop and Basement. The Basement shows 610 times the level compared to outside air and the major species identified was Aspergillus/Penicillium Species. The other spaces ranged from 11.4 to 18.8 percent of outside air.

The Visitor Center Offices and Mechanical Room were the only spaces below the recommended 10% of the total mold count of the outside air.

#### **Bulk Sample Evaluation**

Five bulk samples were taken during this evaluation. Two were taken in the supply duct and three carpet samples were taken.

#### **Supply Ducts -**

The supply duct sample in the main office had 25,000 Colony Forming Unit (CFU)/g of Cladosporium Species, CFU/g of 14,000 Penicillium Species, and 8,300 CFU/g of Aspergillus Candidus. This supply duct is bioactive and can be a source of mold spores in the space. If the duct should become wet from moisture these levels can increase significantly. The total CFU/g for the Main Office duct was 51,000 CFU/g.

The supply duct for the visitor center is supported by a separate air handling unit. This unit was clean and is not bioactive. The total CFU/g for the Visitor Center duct was 100 CFU/g.



## **Carpet -**

The carpet bulk samples showed common outside mold spores. The most common were Cladosporium Species, Basidiomycetes, Alternaria Species, and Aureobasidium Pullulans. The carpet in front of the bathroom showed 8,200 CFU/g of yeast and the carpet in the main office showed 2900 CFU/g of Penicillium Species. The total CFU/g for the Main Office Carpet was 33,000 CFU/g, Visitor Center Office Carpet was 47,000 CFU/g, and the carpet in front of the bathroom was 29,000 CFU/g.



Main Office



Bathroom



Visitor Center



Samples

## **Evaluation of Temperature, Relative Humidity, Carbon Monoxide, and Carbon Dioxide**

On June 4, it was noted that the Visitor during the inspection that the temperature was set at 68 degrees Fahrenheit and the relative humidity was 62% in this area. The air was noticeably damp with moisture. Note: The temperature in the main office area was set at 76 degrees Fahrenheit and the relative humidity was 51%. On June 5, the Visitor Center Office area was tested again after the temperature was set to 76 degrees Fahrenheit. The temperature was 71.8 and the relative humidity was 52.3%.

It is recommended to keep the relative humidity below or near 50 percent. Relative humidity above 50 percent can provide moisture to the environment and allow material become bioactive if there are organic material and mold spores present.

The carbon dioxide level ranged from 381 to 901 parts per million (ppm) during the evaluation. The recommendation for carbon dioxide level is 1,000 ppm.

The carbon Monoxide level ranged from 2.3 to 3.5 ppm during the evaluation. It is recommended that this level be kept as low as possible, but shall never exceed 25 ppm.

The recommendation for setting the temperature in the summer time is between 76 and 78 degrees Fahrenheit. This is for energy conservation.

## **Conclusion:**

Based on the evaluation conducted by the Regional Safety Office, there is evidence of a potential indoor air quality problem for employees with allergies to mold. Level of Aspergillus/Penicillium species are at levels in excess of outside air and have sufficient Colony Forming Units to be bioactive in the space.

## **Recommendations:**

### **Short Term**

- 1) The temperature should be set between 76-78 degrees Fahrenheit in the Visitor Center Offices and Main Office Spaces as there are two air handling units.
- 2) Ensure that the Relative Humidity is maintained near or below 50%. This will ensure that extra moisture is not available in the air to support the growth of mold.
- 3) Clean all carpets throughout the Visitor Center/Office area. If the trailer is going to continue to be used for breaks or meetings, the space should have a deep cleaning which includes cleaning of the carpets.
- 4) Install filter over exhaust ducts in main office area. Use same type of filter that pre-filters the air for the air handling unit.
- 5) Spray basement gravel floor with 10% bleach solution to reduce the mold growth in the basement. I believe the major source of mold growth will be in the soil underneath the gravel.
- 6) Employees having difficulties should work in the Visitor Center offices as this location do not exceed outside air concentrations for Aspergillus/Penicillium species or exceed the recommended 10% of total spore concentration of outside air. The supply ventilation is clean and is not a potential source of mold.
- 7) Clean ceiling in maintenance shop with 10% bleach solution to kill mold growth on ceiling. Paint ceiling with paint with mold and mildew preventive additives.

### **Long Term – If building is going to be used longer than 3 months.**

- 1) Install fan to exhaust air from the basement directly outside to reduce the mold spore level in the basement. Ensure that exhaust from basement is directed away from any air intakes, windows, and doors. If it is feasible, direct exhaust about the roof line of the building.
- 2) Install floor sensors in both bathrooms to detect the grey water back-up prior to contaminating the carpeting outside of the bathrooms.
- 3) Remove insulation from interior of supply and return duct, clean duct work, and install insulation on the outside of the duct work.
- 4) Remove and replace all carpeting as carpeting is beyond life expectancy. It is recommended that floor tile or linoleum be installed as this will be easier to clean if grey water shall back-up from holding tanks.
- 5) Remove windows in wall that was installed to create office space in the visitor center. You can install expanded metal to prevent unauthorized access if you have a security concern. This will allow better exchange of air for this area. Or you can hire a mechanical engineer to evaluate the ventilation to ensure proper ventilations is provided to both locations.

## Mold Species

**Alternaria Species** – Aw – 0.89. Conidia Dimensions 18-83 x 7-18 microns. A very common allergen with an IgE mediated response. It is often found in carpets, textiles and on horizontal surfaces in building interiors. Often found on window frames. Outdoors it may be isolated from samples of soil, seeds and plants. It is commonly found in outdoor samples. The large spore size 20 – 200 microns in length and 7-18 microns in sizes, suggest that the spores from this fungi will deposited in the nose, mouth and upper respiratory tract. It may be related to baker's asthma. It has been associated with hypersensitivity pneumonitis.

**Arthrinium sp.:** *Arthrinium* is a cosmopolitan filamentous fungus isolated from plant debris and soil. There are no infections so far reported due to *Arthrinium* in humans or animals.

**Ascospores:** This is a spore category. They are produced by morels, truffles, cup fungi, ergot and many micro-fungi. They are found everywhere in nature. Spores are predominantly forcibly discharged during periods of high humidity or rain. Allergen Potential is highly variable, dependent on genus and species, but the vast majority do not cause disease. The cellulolytic ascomycetes *Chaetomium* and *Ascotricha* are frequently found growing indoors on damp substrates. Many are parasitic plant pathogens, and sporulate (grow) only on living host plants.

**Aspergillus sp.:** Common cause of extrinsic asthma (immediate-type hypersensitivity: type I) . Acute symptoms include edema and bronchospasms, chronic cases may develop pulmonary emphysema. Members of this genus are reported to cause ear infections. Reported to be allergenic. Many species produce mycotoxins which may be associated with disease in humans and other animals. Toxin production is dependent on the species or a strain within a species and on the food source for the fungus. Some of these toxins have been found to be carcinogenic in animal species. Several toxins are considered potential human carcinogens.

**Aspergillus Candidus:** Found in warm soils, grain and in the secondary decay of vegetation. This mold can produce the toxin petulin which may be associated with disease in humans and other animals.

**Aspergillus niger:** Less common cause of aspergillosis. It has a musty odor. It is commonly found in the environment on textiles, in soils, grains, fruits and vegetables. It has been reported to cause skin and pulmonary infections. It is a common cause of fungal related ear infections-otomycosis.

**Aureobasidium pullulans:** is a cosmopolitan, dematiaceous fungus commonly isolated from plant debris, soil, wood, textiles, and indoor air environment. *Aureobasidium pullulans* is one of the causative agents of phaeohyphomycosis. It may cause keratomycosis, pulmonary mycosis with sepsis and other opportunistic infections, as well as cutaneous mycoses such as eumycotic dermatitis.

**Basidiomycetes sp.;** Fungal spores which are from mushrooms. The specific mushroom species cannot be identified on the culture plate. Many mushroom spores are reported to be allergenic.

**Cladosporium sp. (Hormodendrum sp.)** – Most commonly identified outdoor fungus. The outdoor numbers are reduced in the winter (NC). The numbers are often high in the summer (NC). Often found indoors in numbers less than outdoor numbers. It is a common allergen. Indoor *Cladosporium* sp. may be different than the species identified outdoors. It is commonly found on the surface of fiberglass duct liner in the interior of supply ducts. A wide variety of plants are food sources for this fungus. It is found on dead plants, woody plants, food, straw, soil, paint, and textiles. It can cause mycosis. Produces greater than 10 antigens. Antigens in commercial extracts are of variable quality and may degrade within weeks of preparation. Common cause of extrinsic asthma (immediate-type hypersensitivity: Type I). Acute symptoms include edema and bronchospasms, chronic cases may develop pulmonary emphysema.

**Curvularia sp.:** May cause corneal infections, mycetoma, and infection in immune compromised hosts. This mold has been reported to be allergenic.

**Engyodontium Album:** Engyodontium species are common, but comprise a small proportion of the fungal biota. This very delicate genus is related to Beauveria and Tritirachium. Health effects of Engyodontium album include reports of keratitis, brain abscess, eczema vesiculosum, and native valve endocarditis. No information is available regarding toxicity, and allergenicity has not been studied. Commonly isolated from paper, jute, textiles, and painted walls.

**Epicoccum sp.:** – Conidia Dimensions 15-25 microns. It is a common allergen. It is found in plants, soil, grains, textiles, and paper products. There are no documented cases of *Epicoccum* infection in humans or animals.

**Epicoccum nigrum:** – is a saprophytic mold with a worldwide distribution. It is common on senescent and dead plant and soil. It has also been isolated from wood pulp, canvas, cotton, and a wide variety of stored foods. Indoors it is found in floor, carpet and mattress dust, hospital air, exposed acrylic paint. *Epicoccum nigrum* poses inhalation health risks to persons with weak immune systems. It poses no known dermal inoculation health risk.

**Hyphae:** fungi are composed of filaments called hyphae; their cells are long and thread-like and connected end-to-end. When reproductive hyphae are produced, they form a large organized structure called a sporocarp, or mushroom. This is produced solely for the release of spores, and is not the living, growing portion of the fungus.

**Malbranchea Sp:** colonies are white to sulphur-yellow to ocher-brown in color, suede-like in texture, with a reddish-brown reverse, and often a reddish diffusible pigment. Microscopic morphology shows typical hyaline, one-celled, cylindrical, truncate, alternate arthroconidia produced in terminal fertile portions of the hyphae. Arthroconidia are released by lysis of the disjunct cells. These arthroconidia may be perceived as a yellow dust when released at maturity. Diseases – None.

**Mucor sp.;** Often found in soil, dead plant material, horse dung, fruits and fruit juice. It is also found in leather, meat, dairy products, animal hair, and jute. A Zygomycetes fungus which may be allergenic (skin and bronchial tests). This organism and other Zygomycetes fungus will grow rapidly on most fungal media. May cause mucorosis in immune compromised individuals. The sites of infection are the lung, nasal sinus, brain, eye and skin. Infections may be multiple sites.

**Myxomycetes:** This is a fungal category called Slime molds. There are approximately 45 genera and are found on decaying logs, stumps and dead leaves, particularly in forested regions. These organisms have both dry and wet spores. Wind disperses the dry fruiting body spores, whereas the wet amoebic phase is motile. They have been known to cause Type I allergies (hay fever, asthma). Occasionally found indoors. While a few are distinctive, many of the myxomycete spores are difficult to distinguish from the smuts. These spores are placed in our group "smuts, myxomycetes, Periconia," due to their similar "round, brown" morphology.

**Non-sporulating colonies:** colonies that do not produce spores.

**Penicillium sp. :** Aw 0.78 - 0.88 A wide number of organisms have placed in this genera. Identification to species is difficult. Often found in aerosol samples. Commonly found in soil, food, cellulose and grains. It is also found in paint and compost piles. It may cause hypersensitivity pneumonitis, allergic alveolitis in susceptible individuals. It is reported to be allergenic (skin). It is commonly found in carpet, wall paper, and in interior fiberglass duct insulation (NC). Some species can produce mycotoxins. Common cause of extrinsic asthma (immediate-type hypersensitivity: type I). Acute symptoms include edema and bronchospasms, chronic cases may develop pulmonary emphysema.

**Periconia sp.:** There are approximately 20 species. They grow on soil, blackened and dead herbaceous stems and leaf spots, grasses, rushes and sedges. They are almost always associated with other fungi. Their Allergen Potential has not been studied. A rare case of mycotic keratitis was reported. This has rarely been found growing indoors.

**Phaeoannellomyces sp.:** was created in 1985 to accommodate black yeasts whose yeast cells function as annellides. Colonies grow slowly and resemble pale yeast colonies before turning olive black. This mold may cause tinea nigra, a superficial and asymptomatic fungal skin infection, especially of the palms.

**Phoma sp.:** is a dematiaceous filamentous fungus that inhabits the soil and plant material. *Phoma* species are cosmopolitan in nature and are common plant pathogens. While they are commonly considered as contaminants, *Phoma* species may rarely cause infections in humans.

**Pithomyces sp.:** Causes facial eczema in ruminants. This mold grows on dead grass in pastures.

**Polythrincium sp.:** comprise a very small proportion of the fungal biota. This genus is somewhat related to Ramularia. No information is available regarding health effects, or toxicity. Allergenicity has not been studied. May be identified in air on spore trap samples (spores have distinctive morphology). Also, spores may be seen in dust as part of the normal influx of outdoor microbial particles. Natural habitat is on leaves.

**Rhodotorula Sp.;** A reddish yeast typically found in moist environments such as carpeting, cooling coils and drain pans. In some countries it is the most common yeast genus identified in indoor air. This yeast has been reported to be allergenic. Positive skin tests have been reported. It has colonized terminally ill patients.

**Rusts:** Fungal group which includes Uredinales and Basidiomycetes. There are approximately 14 families, 105 genera and 5,000 species. They grow on grasses, flowers, trees and other living plant materials. Rusts have both wet and dry spores. Wind disperses the urediospores, teliospores, basidiospores, and aeciospores. They have been reported to cause Type I allergies (hay fever, asthma). There are no reports of human infection. Rusts do not grow indoors unless their host plants are present. They are parasitic plant pathogens and need a living host for growth.

**Smuts:** Fungal category which includes Ustilaginales and Basidiomycetes. There are two families, 50 genera, and 950 species. They grow on cereal crops, grasses, weeds, other fungi, and on other flowering plants. Wind disperses the powdery brown teliospores of smut. They have been reported to cause Type I allergies (hay fever, asthma). There have not been any reports of human infection by the plant parasitic forms. Smuts do not usually grow indoors. They are parasitic plant pathogens that require a living host for the completion of their life cycle.

**Scopulariopsis Sp.:** is a filamentous fungus that inhabits soil, plant material, feathers, and insects. It is distributed worldwide. It may produce arsine gas if growing on arsenic substrate. This can occur on wallpapers covered with paris green. It has been found growing on a wide variety of materials including house dust. It is associated with type III allergy.

**Sporobolomyces Sp.:** is reported to be allergenic.

**Torula Sp.:** is reported to be allergenic.

**Yeast:** Various yeasts are commonly identified on air samples. Some yeasts are reported to be allergenic. They may cause problems if a person has had previous exposure and developed hypersensitivity's. Yeasts may be allergenic to susceptible individuals when present in sufficient concentrations.